

## CLAIMS

1. A method of manufacturing articles (2; 4) to be included in cans, in which method a metal strip (1) having an upper surface and a lower surface is fed to a unit (11) for forming the articles (2; 4), characterised in that the strip (1), before being fed to the article forming unit (11), by means of a laser unit (9) is provided with laser engravings on at least one of said upper and lower surfaces of the strip (1), said laser engravings forming marks (A2, CC, 56; WIN, A, 98) on at least one surface of the articles (2; 4).

2. A method as set forth in claim 1, wherein the strip (1) is intermittently fed into the article forming unit (11), and the laser unit (9) is operated to provide the laser engravings on the strip surface when the strip (1) is in a immobilised condition before it is fed into the article forming unit (11).

3. A method as claimed in claim 1 or 2, wherein the laser unit (9) provides about 1-5  $\mu\text{m}$  deep engravings in the strip surface.

4. A method as set forth in claim 1, 2 or 3, wherein a beam (L) of laser radiation in the near IR wavelength range is generated within the laser unit (9).

5. A method as set forth in claim 4, wherein the laser beam (L) is generated in the form of pulsed laser radiation.

6. A method as set forth in claim 4 or 5, wherein the laser beam (L) is generated by means of a Nd:YAG laser, preferably a diode laser pumped Nd:YAG laser.

7. A method as set forth in claim 4, 5 or 6, wherein portions of the laser beam (L) is selectively transmitted through a mode selection element (106), which preferably is arranged within a laser cavity adapted to generate said laser radiation, in order to obtain suitable laser mode characteristics, preferably TEM<sub>00</sub>.

8. A method as set forth in any one of claims 4-7, wherein the laser beam (L) is focused on the strip surface, and wherein the diameter of said laser beam (L) is increased before the beam (L) is being focused.

5 9. A method as set forth in claim 8, wherein the laser beam (L) is focused on the strip surface by means of a flat-field lens (154) having an effective focal length of approximately 120-180 mm.

10 10. A method as set forth in claim 8 or 9, wherein controlled deflection of the laser beam (L) is effected in two mutually perpendicular directions (x, y) for providing the marks (A2, CC, 56; WIN, A, 98) on the articles (2; 4), the laser beam (L) being deflected before being focused.

15 11. A method as set forth in any one of claims 1-10, wherein the article forming unit (11) forms the articles (2; 4) integrated with the strip (1).

20 12. A method as set forth in any one of claims 1-11, wherein the strip (1) is being guided past said laser unit (9).

25 13. A method as set forth in any one of claims 1-12, wherein the strip (1), while passing the laser unit (9), is being guided through a longitudinal channel (220), in which guiding elements (222, 222') bear on opposite longitudinal edges of the strip (1), wherein at least one of the guiding elements (222, 222') is displaceable and biased towards the strip (1).

30 14. A method as set forth in claim 13, wherein each guiding element (222, 222') comprises a freely rotatable body (225) having a peripheral surface (226) which bears on a longitudinal edge of the strip (1).

35 15. A method as set forth in claim 13 or 14, wherein at least one guiding cover (223) is arranged between the guiding elements (222, 222') with a small clearance from one of the upper or lower surfaces of the strip (1), and wherein the laser beam is focused onto the strip surface through an opening (224) in the guiding cover (223).

16. A method as set forth in any one of claims 1-15, wherein the articles (2; 4) are opening tabs (2) to be attached to ends (4) for cans.

17. A method as set forth in claim 16, wherein  
 5 peripheral edge portions (2a, 2b, 2c) of each tab (2) are bent inwardly and an opening (5) is cut in the tab (2), the laser engraving operation being adjusted in such way that the laser engraved marks (A2, CC, 56; WIN, A, 98) are provided on a tab surface between the opening (5) and  
 10 the bent edge portions (2a, 2b, 2c) of the tab (2).

18. An apparatus for manufacturing articles (2; 4) to be included in cans, comprising:

- a supply (8) of a metal strip (1) having an upper surface and a lower surface;
- 15 - a unit (11) for forming the articles (2; 4); and
- means (13) for feeding the strip (1) from the supply (8) to the article forming unit (11);  
 characterised by
- a laser unit (9) arranged between the metal strip  
 20 supply (8) and the article forming unit (11), the laser unit (9) being adapted to provide laser engravings on at least one of said upper and lower surfaces of the strip (1), said laser engravings forming marks (A2, CC, 56; WIN, A, 98) on at least one surface of the articles (2;  
 25 4).

19. An apparatus as set forth in claim 18, wherein the strip feeding means (13) is adapted to effect intermittent movements of the strip (1) into the article forming unit (11), said apparatus further comprising a  
 30 control unit (14) being adapted to operate the laser unit (9) for providing the laser engravings on the strip surface when the strip (1) is in a immobilised condition between said intermittent movements.

20. An apparatus as claimed in claim 18 or 19,  
 35 wherein the laser unit (9) is arranged to provide about 1-5  $\mu\text{m}$  deep engravings in the strip surface.

21. An apparatus as set forth in claim 18, 19 or 20, wherein the laser unit (9) comprises means (100) for generating a beam of laser radiation in the near IR wavelength range.

5 22. An apparatus as set forth in claim 21, wherein the radiation generating means (100) is adapted to provide a beam (L) of pulsed laser radiation.

23. An apparatus as set forth in claim 21 or 22, wherein the radiation generating means (100) is a Nd:YAG laser, preferably a diode laser pumped Nd:YAG laser.

24. An apparatus as set forth in claim 21, 22 or 23, wherein the radiation generating means (100) comprises a laser cavity, and a mode selection element (106) preferably being arranged in said laser cavity, said mode selection element (106) defining an aperture of variable diameter and being arranged to selectively transmit a portion of the laser beam (L) for obtaining suitable laser mode characteristics, preferably TEM<sub>00</sub>.

25. An apparatus as set forth in any one of claims 21-24, wherein the laser unit (9) further comprises beam expansion means (151) for increasing the diameter of the laser beam (L) emitted from the radiation generating means (100), and beam focusing means (154) for focusing the laser beam (L) onto the strip surface, the beam expansion means (151) being arranged upstream of the beam focusing means (154).

26. An apparatus as set forth in claim 25, wherein the beam focusing means comprises a flat-field lens (154) having an effective focal length of approximately 120-180 mm.

27. An apparatus as set forth in claim 25 or 26, wherein the laser unit (9) further comprises a beam deflection means (152), which is adapted to effect a controlled deflection of the laser beam (L) in two mutually perpendicular directions (x, y), the beam deflection means (152) being arranged intermediate the beam expansion means (151) and the beam focusing means (154).

28. An apparatus as set forth in any one of claims 18-27, wherein the article forming unit (11) is arranged to form the articles (2; 4) integrated with the strip (1).

5 29. An apparatus as set forth in any one of claims 18-28, wherein the laser unit (1) is arranged in the immediate vicinity of article forming unit (11), although being physically unconnected thereto.

10 30. An apparatus as set forth in any one of claims 18-29, further comprising means (12) for guiding said strip (1) past said laser unit (9).

15 31. An apparatus as set forth in claim 30, wherein said guiding means (12) includes a longitudinal channel (220) for receiving said strip (1), the channel (220) being at least partly defined by guiding elements (222, 222') which are arranged for abutment against opposite longitudinal edges of the strip (1), wherein at least one of the guiding elements (222, 222') is displaceable and biased towards the channel (220).

20 32. An apparatus as set forth in claim 31, wherein each guiding element (222, 222') comprises a freely rotatable body (225) having a peripheral surface (226) for abutment against a longitudinal edge of the strip (1).

25 33. An apparatus as set forth in claim 31 or 32, wherein the channel (220) is further defined by at least one guiding cover (223), which is arranged between the guiding elements (222, 222') with a small clearance from one of said upper or lower surfaces of the strip (1), the guiding cover (223) defining an opening (224) allowing  
30 the laser unit (9) to provide laser engravings on said one surface.

35 34. An apparatus as set forth in any one of claims 18-33, wherein the laser unit (9) operation is disconnectible for allowing article manufacture without marking of the strip (1).

35. An apparatus as set forth in any one of claims 18-34, wherein said articles (2; 4) are opening tabs (2) to be attached to ends (4) for cans.

36. An apparatus as set forth in claim 35, wherein the article forming unit (11) has means for bending peripheral edge portions (2a, 2b, 2c) of each tab (2) inwardly, and means for cutting an opening (5) in the tab (2), the laser unit (9) being adjustable in such way that the laser engraved marks (A2, CC, 56; WIN, A, 98) are provided on a tab surface between the opening (5) and the bent edge portions (2a, 2b, 2c) of the tab (2).

37. An opening tab to be fastened on an end (4) for a can, characterised in that it has laser engraved marks (A2, CC, 56; WIN, A, 98) on its top or bottom surface, or on both these surfaces.

38. An opening tab as set forth in claim 37, comprising inwardly bent peripheral edge portions (2a, 2b, 2c) and an opening (5), the laser engraved marks (A2, CC, 56; WIN, A, 98) being provided on a tab surface between the opening (5) and the edge portions (2a, 2b, 2c) of the tab (2).

39. A can end, characterised in that it has an opening tab (2) as claimed in claim 37 or 38.

40. A shell for a can, characterised in that it has laser engraved marks on its top surface.

41. A can, characterised in that it has laser engraved marks on its outer surface, preferably on its bottom surface, or that it has an end (4) which is provided with laser engraved marks.

42. Use of a laser for providing markings (A2, CC, 56; WIN, A, 98) in the shape of laser engravings on articles (2; 4) to be included in cans, especially beverage cans.

43. Use as set forth in claim 42, wherein said articles (2; 4) are opening tabs (2) for can ends (4).